

CLADOCERAN MALES FROM THE INDIAN REGION¹

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(With fifty-two text-figures)

Key word: Cladocera, males, records

Very few Cladocera males have been reported from India. They are uncommon in nature. This study, describes males of sixteen species from six families of Cladocera, collected in different parts of India including Andaman and Nicobar islands.

INTRODUCTION

The routine identification of Cladoceran species is based on characters of mature females such as body size, head shape, nature of postabdomen and head shield. These are variable featured hence, it is important to examine several specimens from a population for identification. Frey (1987) has shown that males are more important in defining the species than the parthenogenetic females, as they are readily recognised by their antennules, which are longer than those of the female and are mobile with well developed setae; these characteristic features are used in species identification. However, males are always rare in populations and their collection is seasonal. Therefore males of most species of Cladocera have often remained unknown. This study describes males of sixteen species of Cladocera belonging to six families occurring in Tamil Nadu (8°-12° N), Rajasthan (27° 7.6'-27° 12.2' N) (Keoladeo National Park, Bharatpur and neighbouring area), Andaman and Nicobar Islands (10° 30'-13° 15' N) and West Bengal (23°-24° N).

MATERIAL AND METHODS

Cladoceran samples were collected throughout Tamil Nadu, certain parts of Rajasthan (Keoladeo National Park, Bharatpur and adjacent areas), Andaman and Nicobar Islands and West Bengal from various types of habitat such as rice fields, marshes, ponds, lakes, reservoirs, streams and rivers. A plankton net of 45 cm diameter was dragged close

to the bottom in shallow water, among vegetation and in open water areas. Samples were then immediately fixed and preserved in 5% formalin. A total of 16 species of freshwater Cladocera males were examined (Table 1).

DESCRIPTION

1. *Latonopsis australis* Sars, 1885 (Figs. 1-3)

Material examined: Madurai, Tamil Nadu.

MALE: Body size 0.73 mm. Body oblong. Head short and thick, visually not separated from the body (Fig. 1). Eye large, situated near antero-dorsal end of the head. Ocellus small. Antennules long, attached to antero-ventral corner of head; with a club-shaped series of setae on the proximal end (Fig. 2). Segmentation in antennule not clearly visible. Postabdomen short with two long sperm ducts. Lateral surface armed with a series of 4-5 denticles. Claw pointed and curved dorsally and with 2 long basal spines (Fig. 3). Proximal end of the postabdomen with 2 long natatorial setae.

2. *Diaphanosoma excisum* Sars, 1885. (Figs. 4-6).

Material examined: Madurai, Tamil Nadu.

MALE: Body size 0.98 mm. Head large and rounded anteriorly. Eye relatively small. Duplication forming an acute angle with the ventral margin anteriorly; postero-ventral corner broadly rounded with 6-8 marginal denticles followed by a series of fine setules and ending in 2 long spines (Fig. 4).

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TABLE I
LIST OF CLADOCERA MALES SO FAR RECORDED
(RECORDS ARE GIVEN IN PARENTHESES)

Family	SIDIDAE
Genus	<i>Latonopsis</i>
	1. <i>L. australis</i> Sars, 1885 (China, Sieh-chih and Nan-shan 1979)
Genus	<i>Diaphanosoma</i>
	2. <i>D. excisum</i> Sars, 1885 (China, Sieh-chih and Nan-shan 1979)
Family	DAPHNIDAE
Genus	<i>Daphnia</i>
	3. <i>D. similis</i> Claus, 1876
	4. <i>D. cephalata</i> King, 1852 (Australia, Hebert 1977; India, Venkatarman 1991)
	5. <i>D. projecta</i> Hebert, 1977 (India, Venkatarman and Krishnaswamy 1984)
Family	MOINIDAE
Genus	<i>Moina</i>
	6. <i>M. micrura</i> Kurz, 1874 (India, Venkatarman 1983, Michael and Sharma 1989; USA, Goulden 1984)
	7. <i>M. weismanni</i> Ishikawa, 1896 (India, Venkatarman and Krishnaswamy 1984)
Genus	<i>Moinodaphnia</i>
	8. <i>M. macleayi</i> (King, 1853) (Africa, Goulden 1968)
Family	MACROTHRICIDAE
Genus	<i>Macrothrix</i>
	9. <i>M. spinosa</i> King, 1852
Family	CHYDORIDAE
Genus	<i>Alona</i>
	10. <i>Alona davidi punctata</i> Richard, 1895
	11. <i>A. pulchella</i> King, 1853 (Malaysia, Idris 1983)
Genus	<i>Biapertura</i>
	12. <i>B. karna</i> King, 1853 (India, Venkatarman 1983, Michael and Sharma 1989; China, Sieh-chih and Nan-shan 1979)
	13. <i>B. verrucosa</i> Sars, 1901 (China, Sieh-chih and Nan-shan 1979)
Genus	<i>Kurzia</i>
	14. <i>K. longirostris</i> (Daday, 1989) (Africa, Smirnov 1977)
Genus	<i>Leydigia</i>
	15. <i>L. ciliata</i> Gauthier, 1939 (Australia, Smirnov 1977)
Family	BOSMINIDAE
Genus	<i>Bosminopsis</i>
	16. <i>B. deitersi</i> Richard, 1895 (China, Sieh-chih and Nan-shan 1979)

Antennules long and attached to the postero-ventral part of head, with a group of short setae attached at 1/5 of its length with a row of fine setules decreasing in size up to the tip (Fig. 5). Postabdomen with 2 long sperm ducts. Claw with a series of spinules increasing in size proximally and with 3 long, sharply pointed basal spines (Fig. 6).

3. *Daphnia similis* Claus, 1876
(Figs. 7-10)

Material examined: Madurai, Tamil Nadu; Bharatpur, Rajasthan.

MALE: Body size 1.38 mm. Carapace oblong.

Tail short. Head small, rostrum undeveloped (Fig. 7). Antennules long with well developed flagellum (Fig. 8). Eye large, ocellus conspicuous. Abdominal processes greatly reduced. Dorsal postabdominal margin strongly sinuate, with 6-8 anal spines (Fig. 9). Anterior margin of the valve with setae. Leg I modified as a hook with a long flagellum (Fig. 10).

4. *Daphnia cephalata* King, 1852
(Figs. 11-14)

Material examined: Madurai and Tirunelveli, Tamil Nadu.

MALE: Body size 1.08 mm. Head large and

rounded (Fig. 11). Anterior margin of valve with fine setules up to 1/3 of the ventral margin. Antennules long with well developed flagellum. Terminal seta short, distally plumose. Basopodite with no rows of spinules (Fig. 12). Leg I with a hook and a long seta (Fig. 13). Postabdomen with no dorsal process. Claw slightly curved, 11-14 anal spines, relatively short, robust and subequal. Dorsal margin flat (Fig. 14).

5. *Daphnia projecta* Hebert, 1977

(Figs. 15-17)

Material examined: Madurai, Tamil Nadu.

MALE: Body size 0.9 mm. Head large with anteriorly projecting helmet; rostrum absent; dorsal margin of head and body straight with spines (Fig. 15). Antennules well developed and movable; flagellum in the antennules not well developed (Fig.

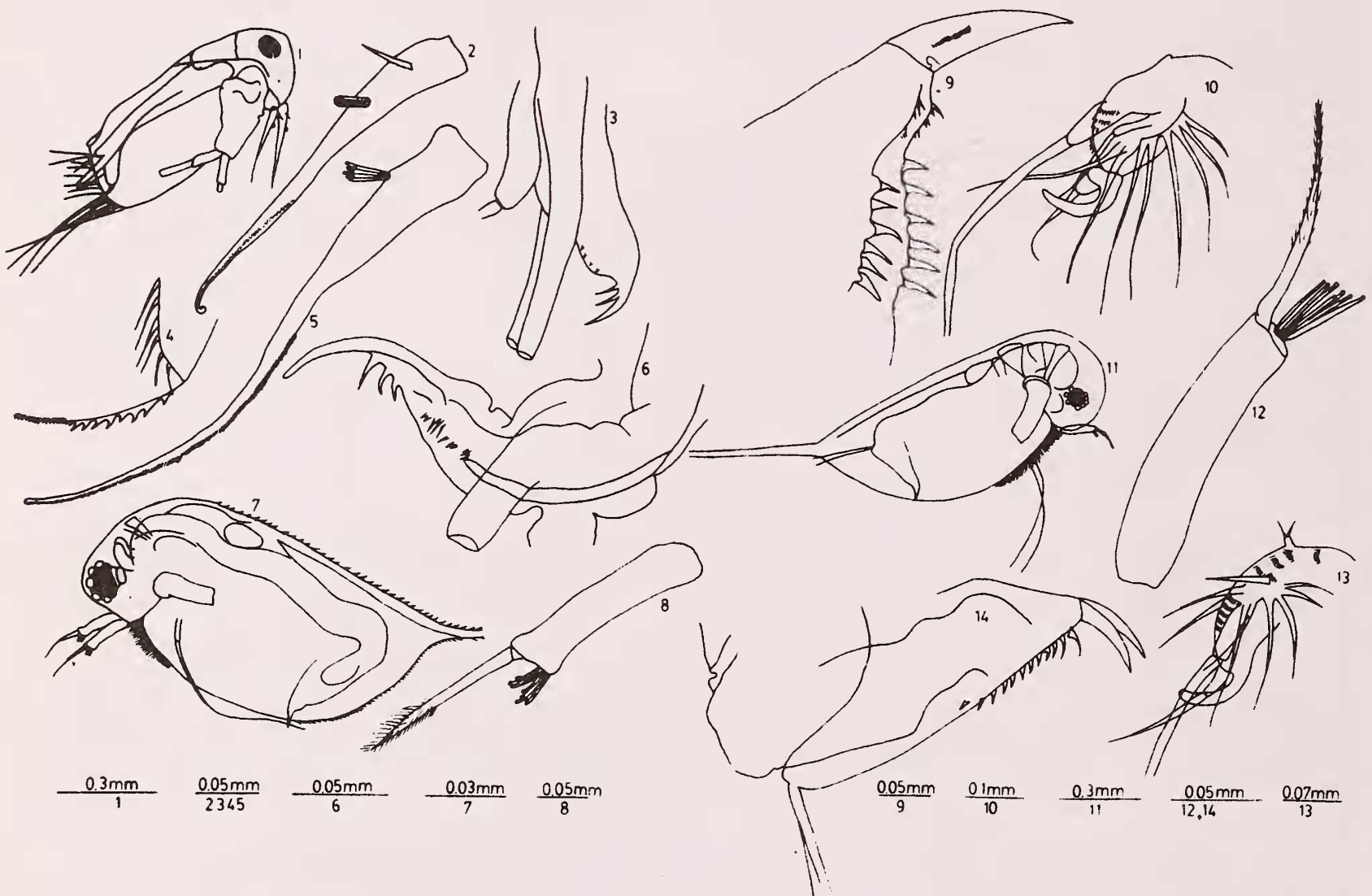
16). Eye moderately large, ocellus inconspicuous. Ventral margin convex. Tail long. The first pair of legs modified to form a prehensile organ which terminate in a long seta protruding beyond the shell to the exterior. Total size smaller than female. Postabdominal process not present; dorsal margin with 10-12 anal spines (Fig. 17).

6. *Moina micrura* Kurz, 1874

(Figs. 18-21)

Material examined: Madurai, Tamil Nadu.

MALE: Body size 0.62 mm. Body oblong; head narrow and extended anteriorly (Fig. 18). Well developed supraocular depression. Eye large. Antennules long and bent at 1/3 the distance from the head, with three hooks at the tip. Two sensory setae, one short and another originating at the knee



Figs. 1-3: *Latonopsis australis* Sars: (1) male (entire); (2) antennule; (3) postabdomen.

Figs. 4-6: *Diaphanosoma excisum* Sars: (4) postero-ventral corner; (5) antennule; (6) postabdomen.

Figs. 7-10: *Daphnia similis* Claus: (7) male (entire); (8) antennule; (9) postabdomen; (10) leg I.

Figs. 11-14: *Daphnia cephalata* King: (11) male (entire); (12) antennule; (13) leg I; (14) postabdomen.

of the bend (Fig. 19). First leg with a well developed hook extended at right angles to the leg (Fig. 20). Postabdomen similar to female with setae on claw, a pair of feathered teeth on the dorsal side (Fig. 21).

7. *Moina weismanni* Ishikawa (1896)
(Figs. 22-25)

Material examined: Madurai, Tamil nadu.

MALE: Body size 0.7 mm. Body oblong. Supraocular depression distinct (Fig. 22). Antennule bent at a point about 1/4 the distance from the head with four hooks at the tip (Fig. 23). Leg I with a weakly developed hook (Fig. 24). Postabdomen similar to that of female with varying number of feathered teeth (Fig. 25).

8. *Moinodaphnia macleayi* (King, 1853)
(Figs. 26-29)

Material examined: Wandoor, Port Blair,

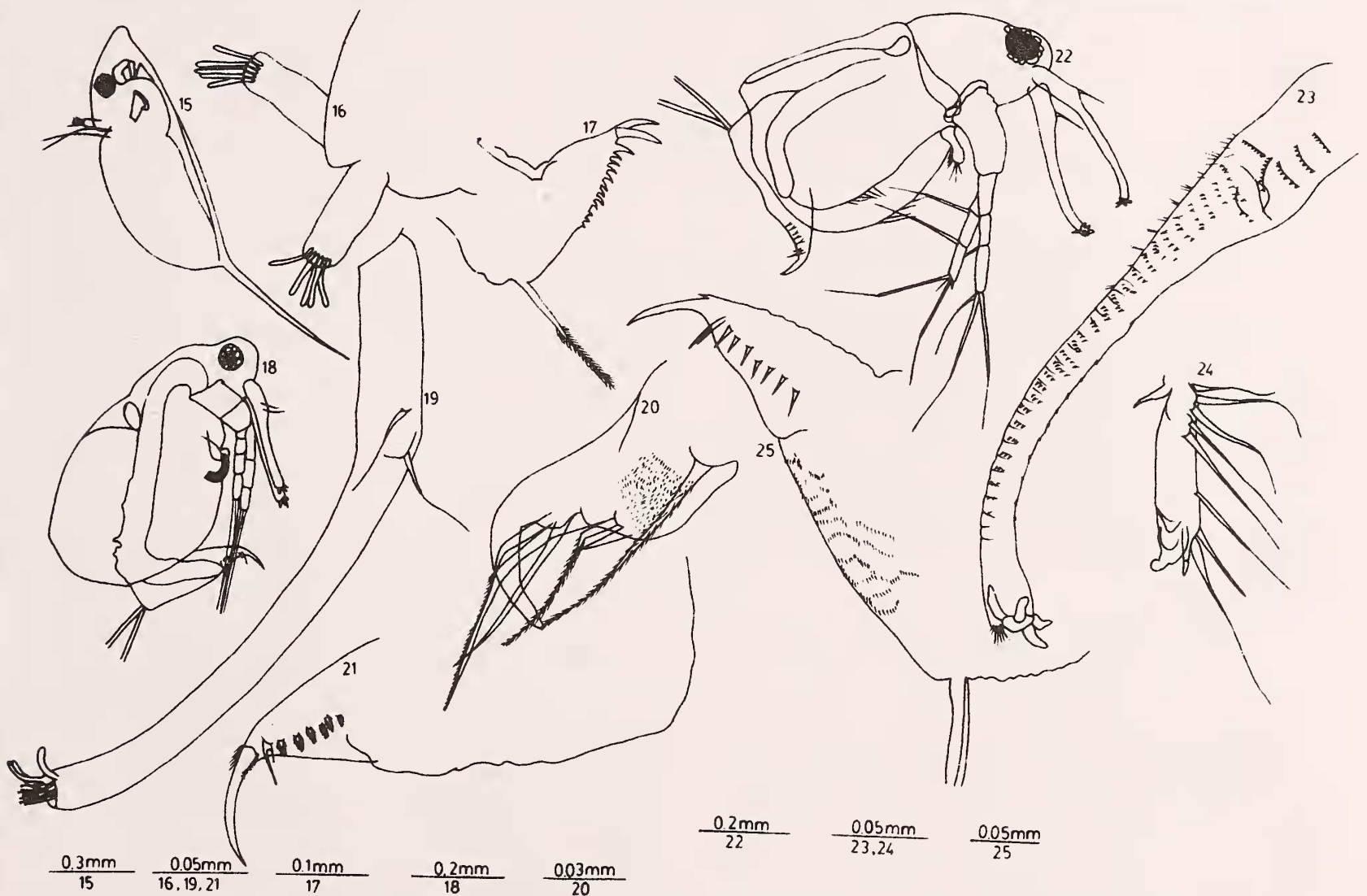
Andaman and Nicobar Islands.

MALE: Body size 0.76 mm. Head elongated with a large eye (Fig. 26). Ocellus present. Antennules long and curved with sensory papillae at the distal tip (Fig. 27). First leg with a large curved hook (Fig. 28). Postabdomen similar to that of female with 6-7 feathered teeth (Fig. 29).

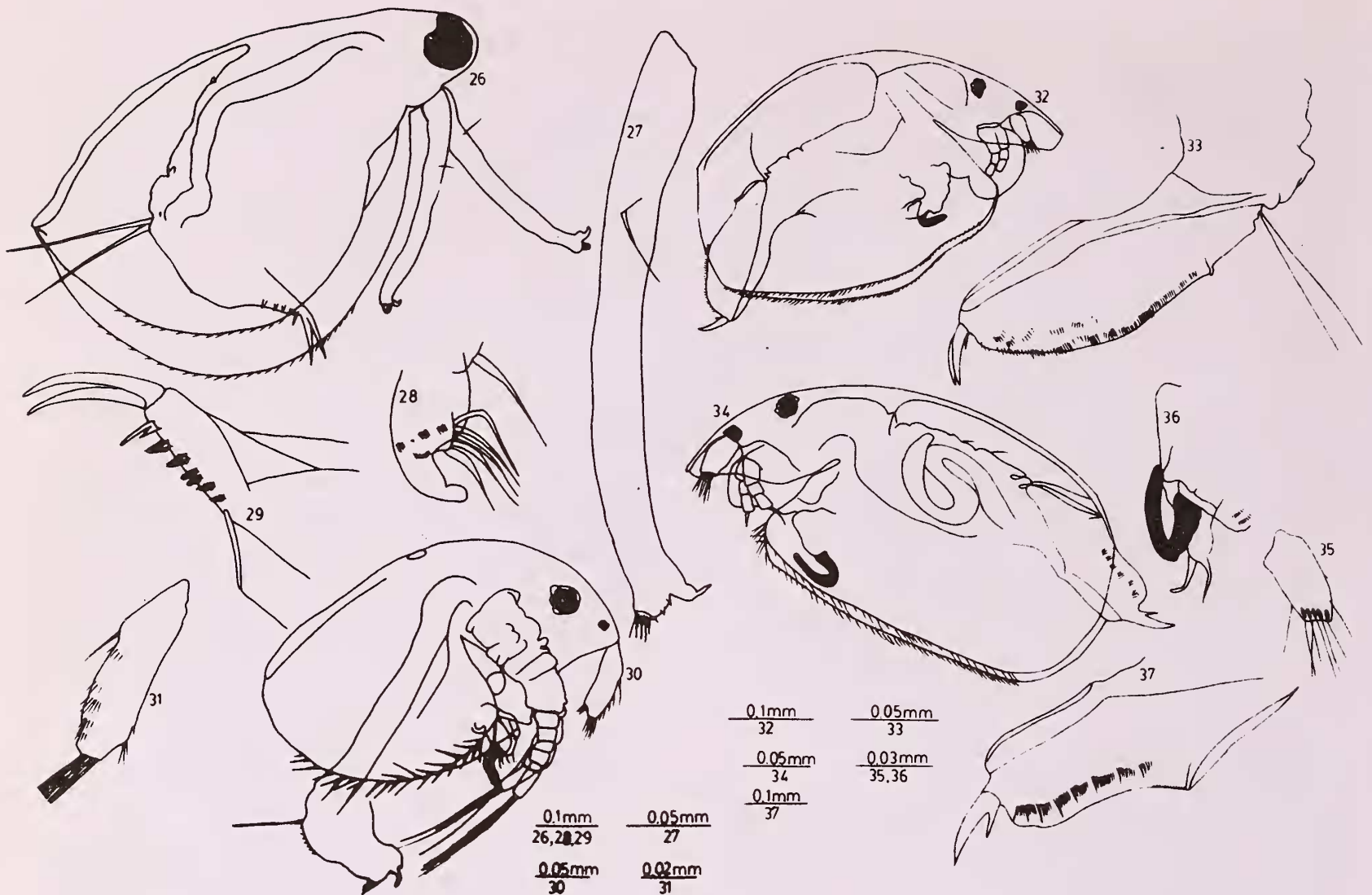
9. *Macrothrix spinosa* King, 1852
(Figs. 30-31)

Material examined: Bharatpur, Rajasthan; Madurai, Tamil Nadu.

MALE: Body size 0.33 mm. Carapace rounded-oval, with scale-like patterns; posterior margin blunt, ventral margin broadly rounded, serrated and with a series of long setae (Fig. 30). Antennules short with a long seta near the base and a series of spinules arranged transversely on entire surface and a group



Figs. 15-17: *Daphnia projecta* Hebert: (15) male (entire); (16) antennule; (17) postabdomen.
Figs. 18-21: *Moina micrura* Kurz: (18) male (entire); (19) antennule; (20) leg I; (21) postabdomen.
Figs. 22-25: *Moina weismanni* Ishikawa: (22) male (entire); (23) antennule; (24) leg I;
(25) postabdomen.



Figs. 26-29: *Moinodaphnia macleayi* King: (26) male (entire); (27) antennule; (28) leg I; (29) postabdomen.

Figs. 30-31: *Macrothrix spinosa* King: (30) male (entire); (31) antennule.

Figs. 32-33: *Alona davidi punctata* Richard: (32) male (entire); (33) postabdomen.

Figs. 34-37: *Alona pulchella* King: (34) male (entire); (35) antennule; (36) leg I; (37) postabdomen.

of sensory setae on the apex (Fig. 31). Postabdomen broadly rounded with indistinctly concave anal margin. Claw short, curved dorsally and serrated on the surface. As in the female, dorsal distal corner rounded, armed with a group of strong, sharply pointed denticles.

10. *Alona davidi punctata* Richard, 1895 (Figs. 32-33)

Material examined: Madurai, Tamil Nadu.

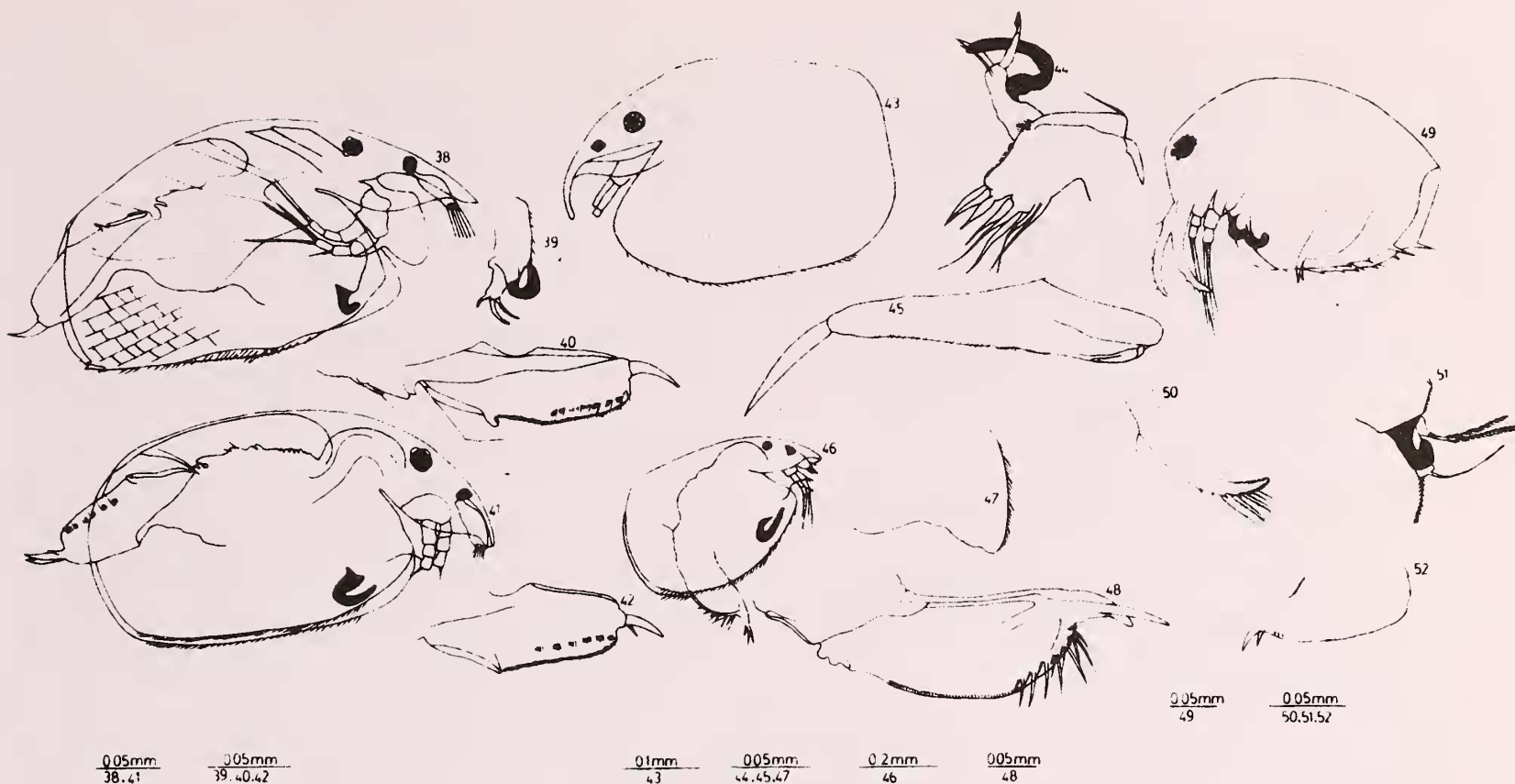
MALE: Body size 0.42 mm. Dorsal part of the body highly arched and moon shaped. Postero-ventral and postero-dorsal corners rounded. Ventral margin projecting in the middle (Fig. 32). Rostrum blunt. Antennules not reaching the apex of rostrum. Plate of labrum rounded anteriorly, evenly curved posteriorly. Postabdomen widest at middle, then

tapering distally with prominent preanal and postanal corners. Claw with very short basal spine. Sperm duct open at the ventral side at the base of the claw (Fig. 33).

11. *Alona pulchella* King, 1853 (Figs. 34-37)

Material examined: Madurai, Tamil Nadu.

MALE: Body size 0.33 mm. Dorsal and ventral margins of valves almost parallel. Postero-dorsal and postero-ventral corner of valves rounded (Fig. 34). Ocellus smaller than eye, situated half way between the eye and the apex of rostrum. Antennules stout and broad with two setae at dorsal and ventral side (Fig. 35). Labral plate about the same as in female, first leg with a copulatory hook (Fig. 36). Postabdomen short, dorsal margin of postabdomen



Figs. 38-40: *Biapertura karua* King: (38) male (entire); (39) leg I; (40) postabdomen.

Figs. 41-42: *Biapertura verrucosa* Sars: (41) male (entire); (42) postabdomen.

Figs. 43-45: *Kurzia longirostris* (Daday): (43) male (entire); (44) leg I; (45) postabdomen.

Figs. 46-48: *Leydigia ciliata* Gauthier: (46) male (entire); (47) labrum; (48) postabdomen.

Figs. 49-52: *Bosminopsis deitersi* Richard: (49) male (entire); (50) antennule; (51) leg I; (52) postabdomen.

without denticles, lateral side with 8 groups of setae, the distalmost seta being the longest of each group and slightly projecting beyond the dorsal margin. Anal margin with spines. Claw short with a short basal spine (Fig. 37).

12. *Biapertura karua* King, 1853 (Figs. 38-40)

Material examined: Madurai, Tamil nadu.

MALE: Body size 0.31 mm. Maximum height of body slightly before middle. Valves with distinct lines and polygonal patterns (Fig. 38). Postero-ventral corner rounded with 2 to 3 denticles attached marginally. Ocellus smaller than eye, situated closer to the eye. Plate of labrum rounded anteriorly, slightly pointed ventrally with or without a notch on the apex. Leg I modified into a hook (Fig. 39). Postabdomen with distinct preanal and postanal corners with rounded dorsal-distal margin. About 8 groups of denticles attached submarginally at the lateral side. Claw with or without basal spine (Fig. 40).

13. *Biapertura verrucosa* Sars, 1901 (Figs. 41-42)

Material examined: Madurai, Tamil Nadu.

MALE: Body size 0.29 mm. Postero-dorsal and postero-ventral corner of the valve rounded (Fig. 41). Rostrum blunt, antennules long, almost reaching apex of rostrum. Ocellus smaller than eye. Plate of labrum rounded with a denticle on the anterior margin. Postabdomen with distinct preanal and postanal corners and rounded on dorsal-distal corner. A series of small spines attached along the dorsal margin. Lateral side of postabdomen with 6 to 7 groups of setae, the distalmost seta being the longest of each group and projecting beyond the anal margin (Fig. 42). Claw with relatively short basal spine.

14. *Kurzia longirostris* (Daday, 1898) (Figs. 43-45)

Material examined: Madurai, Tamil Nadu.

MALE: Body size 0.42 mm. Body evenly

rounded dorsally and convex posteriorly, maximum height before middle (Fig. 43). Rostrum long and pointed ventrally. Ocellus smaller than eye, twice nearer to the eye than to the apex of rostrum. Leg I modified into a hook (Fig. 44). Postabdomen long, tapering distally. Dorsal surface with relatively small spines submarginally. Claw rather long, curved, without basal spine (Fig. 45).

15. *Leydigia ciliata* Gauthier, 1939
(Figs. 46-48)

Material examined: Madurai, Tamil Nadu.

MALE: Body size 0.53 mm. Postero-dorsal corner of valve at level of maximum height. Postero-ventral corner rounded (Fig. 46). Ocellus larger than eye. Antennules not reaching apex of rostrum. Plate of labrum with pubescent anterior margin (Fig. 47). Postabdomen widest in the middle, distal corner rounded; lateral groups each with 3 setae, distal seta longest in each group, proximal seta shortest. Claws without basal spine. Vas deferens opening on apex of penis-like process (Fig. 48).

16. *Bosminopsis deitersi* Richard, 1895
(Figs. 49-52)

Material examined: Ganga River, Barrackpore, West Bengal.

MALE: Body size 0.29 mm. Body oval in shape. Postero-dorsal corner distinct, postero-ventral corner with spines (Fig. 49). Head large with a long rostrum. Antennules long, with about 5-6 sensory setae near the apex (Fig. 50). Eye large. Valves with faint polygonal reticulations. Leg I with a hook (Fig. 51). Postabdomen small, tapering distally with small spines on the dorsal side. Claw with a large serrated basal spine (Fig. 52).

DISCUSSION

Among the 93 species of Cladocera recorded from India (Michael and Sharma 1988), only 13 males have been described so far. Likewise, out of 62 species of Cladocera collected from Malaysia (Idris 1983), only 2 males have been found. Sieh-chih and Nan-Shan (1979) described 136 species of Cladocera from China and described 48 males. Swar

and Fernando (1979) described 23 species of Cladocera from Nepal without a single representation of male. There are thus several examples to show that the males of Cladocera are rare. From the present study it appears that in tropical and subtropical latitudes of India, males usually appear for a very short period and sometimes in small numbers, so that most collections do not contain males unless special efforts are made. Chengalath (1982) also found the same phenomenon of rarity of males in the case of temperate cladocerans.

The causes of production of males at a particular time of the season are not fully understood. Some of the possible reasons are temperature, food and overcrowding (Pennak 1978). The number of pre-reproductive instars of males vary from species to species. Life history studies on the males have been worked out for a few species only. Das *et al.* (1981) have studied the life history of males of *D. lumholtzi*. Likewise, Venkataraman (1990a, b) studied the life history of males of *D. similis*, *D. cephalata* and *Moina weismanni*. From these studies it has been found that adult males are not similar to adult females; however, juvenile males have some similarity to the females. Adult males tend to be more highly differentiated than the females, particularly in the structure of the antennule as in the case of Sididae, Daphnidae and postabdominal claws as in Chydoridae, so that males are sometimes essential in determining the identity of the species. Another important character that differentiates males from females is the presence of a hook in the first trunk limb. This often helps the male to hold the female during mating. The male postabdomen bears a pair of vas deferens which protrude like a long tube in Sididae and Chydoridae, and it also appears as two openings at the base of the claw in other families.

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